UNITED STATES OF AMERICA

TO WHOM IT MAY CONCERN:

BE IT KNOWN THAT Simona PILONE

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has invented certain new and useful improvements in and relating to: "A device for supplying pressurized air through the hub to the tire of a motor vehicle wheel" of which the following is a specification.

DESCRIPTION

The present invention refers to a device for supplying pressurized air to the tire of a vehicle wheel through the wheel hub. The invention further refers to a bearing assembly for the hub of a vehicle wheel equipped with such a device.

There are known bearing units for a vehicle wheel hub provided with special vents and sealing devices for inflating into the tire air pressurized by means of a source of a pressurized air mounted on board of the vehicle. This solution allow to adjust and/or monitor the air pressure of the tires.

For a better understanding of the state of the art and problems inherent thereto, there will be at first described a bearing unit of the above mentioned type, with reference to figure 1 of the accompanying drawings. A bearing unit of this kind is known, for example, from EP-713 021, EP-656 267, US-5 503 480, DE-37 38 529, FR-2 714 943.

In figure 1, a bearing unit comprises an outer race 1, an inner race 2 formed by two axially adjacent half-races, and two sets of bearing balls 3. In a radial plane located between the two sets of balls 3 there are several outer radial ducts 6 passing through the bearing outer race 1, and several inner radial passages 7 formed through the bearing inner race 2.

Mounted in the annular space defined by the outer race 1, the inner race 2 and the two sets of balls 3 is a sealing device 8 that allows pressurized air to pass through the outer 6 and inner 7 ducts of the bearing. The sealing device is

constituted by two annular sealing members 9 facing one another axially and disposed symmetrically with respect to the radial plane in which the ducts 6 and 7 of the bearing unit lie. Each sealing element 9 generally comprises a metal reinforcement on which there is molded a flexible material, such as an elastomeric material. The metal reinforcement is formed by a sheet metal bent so as to have a portion 10 that is axially fixed to the outer race 1 of the bearing and a radial portion for stiffening the flexible material molded thereon that extends to form a flexible wall 11. The free end of the wall 11 is constituted by a lip 12, preferably of a low friction material such as Teflon™, that slidingly contacts a contact surface 13 formed by the inner race 2 of the bearing. The two sealing elements 9 so arranged delimit an intermediate annular chamber 14. Air pressurized by a pressurized air source mounted on board of the vehicle, which may be part of an automatic system or a system controlled by the driver, passes through special ducts obtained in the suspension standard of the wheel where the bearing is housed, passes through the outer ducts 6, in the intermediate annular chamber 14, through the inner ducts 7, and from here is conveyed through other ducts to the wheel rim and finally the tire.

The object of the present invention is to allow to inflate pressurized air to the wheel tire through the hub, without having to form conventional radial bores in the inner and outer races of the bearing. On the one hand, forming such bores involves a constructional complication which may adversely affect the bearing raceways, which, as known have very low admissible tolerances. On the other hand, pressurized air passing through the bearing may considerably shorten its life, should the sealing devices delimiting the

above describe intermediate annular chamber be faulty.

This and other objects and advantages, that will be better understood in the following, are accomplished according to the invention by a device and a bearing assembly having the features defined in the appended claims.

There will now be described the constructional and functional features of a few preferred but not limiting embodiments of the device and the bearing assembly according to the invention. Reference is made to the accompanying drawings, in which:

figure 1 is an axial cross-sectional view of a bearing unit of known kind through which there are formed passages for pressurized air;

figure 2 is a schematic and partial cross-sectional view of a first embodiment of a bearing assembly equipped with a device according to the invention;

figure 3 is a schematic axial cross-sectional view of a second embodiment of a bearing assembly with a device according to the invention;

figure 4 is a schematic axial cross-sectional view of a conventional bearing assembly equipped with a device for detecting relative speed of rotation between the bearing races;

figure 5 is a partial and schematic axial cross-sectional view of a third embodiment of a bearing assembly equipped with a device according to the invention;

figure 6 is a schematic axial cross-sectional view of a fourth embodiment of a bearing assembly equipped with a device according to the invention;

figure 7 is a partial and schematic cross-sectional view of a fifth embodiment of a bearing assembly equipped with a device

according to the invention;
figure 8 is a schematic axial cross-sectional view of a fifth embodiment of a bearing assembly equipped with a device according to the present invention;
figure 9 is a partial and schematic axial cross-sectional view of a seventh embodiment of a bearing assembly equipped with a device according to the present invention; and
figure 10 is a schematic axial cross-sectional view of an eighth embodiment of a bearing assembly equipped with a device according to the present invention.

Referring to figures 2 and 3, a bearing unit indicated overall A comprises a stationary outer race 1, a pair of rotatable inner races 2 and 3 sets of rolling elements 4, 5, in this example balls, radially interposed between the outer race 1 and the inner races 2, 3.

The bearing unit shown herein is a standard unit of the so called I generation. However, reference to this possible field of application should not be in any way interpreted as limiting the scope of the patent, as the invention is equally applicable to bearing units with flanged races.

Formed preferably at one end of the outer race 1 is a circumferential peripheral recess 6. Bearings having a circumferential recess of this kind are currently already used, as schematically shown in figure 4, to allow to mount an annular cover 7 carrying a sensor 8 facing an impulse ring 9 fast for rotation to one of the rotatable inner races of the bearing. The cover 7 forms a circumferential projection 10 having a shape that matches that of the recess 6 of the outer race 1 to facilitate coupling therewith.

Still referring to figure 2, according to the present invention the bearing unit A is coupled to a device B for supplying pressurized air to the tire (not shown) of the wheel through the hub (not shown) on which the inner races 2, 3 of the bearing are fixed in known manner.

The device B comprises a stationary outer ring 11 and a rotatable inner ring 12. In an essentially central radial plane P there is formed an outer radial passage 13 through the outer ring 11, and one or more inner radial passages 14 through the inner ring 12. The outer passage 13 is formed between the outer cylindrical surface 20 and the inner cylindrical surface 11a of the outer ring 11. The internal passage 14 is formed between the outer cylindrical surface 12a and the inner cylindrical surface 12b of the inner ring 12.

Disposed in the annular space between the outer ring 11 and the inner ring 12 is a sealing device formed, in this example, by two separate annular sealing elements 15, 16 that are disposed axially facing one another and symmetrically with respect to the central radial plane P in which the ducts or bores 13 and 14 lie. An intermediate annular chamber 17 is so defined laterally by the sealing elements 15, 16, externally by the outer ring 11 and internally by the inner ring 12. The chamber 17 communicates and allows the passage of pressurized air through the bores 13 and 14 to further ducts and tubes (not shown) respectively interposed between the outer bore 13 and a source of pressurized air mounted on board of the vehicle, and between the inner bores 14 and the wheel tire.

The constructional features of the sealing devices 15, 16 are

per se known and will not therefore be described in further detail in this specification. For the construction of the parts and elements not shown in detail, reference may therefore be made to any of the documents mentioned in the introductory part of the description. Other constructional solution may be found, for example, in US-5 221 381, EP-521 719, US-5 080 156, GB-2 223 207, US-4 844 138, EP-208 540.

To improve coupling between the outer ring 11 of the device B and the outer race 1 of the bearing unit A, the outer ring 11 preferably forms an axially protruding edge 18 having a shape matching that of the recess 6 of the outer bearing race 1 and accommodated in such recess.

In the assembled condition, the outer ring 11 of the device B is stationary with the outer bearing race 1 adjacent thereto, and the inner ring 12 of the device B is fast for rotation with the adjacent rotatable inner races 2, 3 of the bearing unit A.

In the embodiment shown in figure 2, the duct 13 of the outer ring 11 is radial and opens on the cylindrical outer surface 20 of the ring 11 for communicating for example with a passage formed in the standard of the suspension (not shown) that houses the bearing.

In the second embodiment, shown in figure 3, the outer duct 113 obtained in the stationary outer ring 11 is elbow-shaped and opens on a side face 21 of the ring 11, for example in order to receive the supply of pressurized air through a conduit or a tube separate from the suspension standard.

In the third embodiment, shown in figure 5, the assembly consisting of the bearing unit A and the device B is coupled to a device C for detecting relative speed rotation between the bearing races. The device C, *per se* known, comprises a cover mounting element 7 supporting a sensor 8 and facing an impulse ring 9 secured for rotation with the inner rotatable ring 12 of the device B. The mounting cover 7 is fixed to the outer stationary ring 11 by means of an axially protruding edge 10 that is accommodated in a peripheral circumferential recess 22 formed in the outer ring 11 on the side opposite to that having the protruding edge 18.

In the fourth embodiment, shown in figure 6, the passage 113 formed through the outer ring 11 of device B opens on the side surface 21 of the ring 11, similarly as shown in the variant of figure 3. The sensor-carrying cover 7 further forms a bore 23 axially aligned with the side opening of the passage 113.

The further embodiments shown in figure 7, 8, 9 and 10 differ from the preceding ones essentially for the kind of outer bearing race that is used. In figures 7 to 10, the stationary outer bearing race 1 forms on one side a shoulder 24 that is made to abut against an axially inner side of the suspension standard M. The opposite end of the outer race 1 is cold formed, preferably by rolling in a *per se* known manner, forming an edge 25 that projects radially against the axially outer surface of the standard M so as to axially lock the bearing unit A to the suspension. The axially protruding edge 18 of the outer ring 11 of the device B is couples with the shoulder 24 of the outer race 1 of bearing unit A. Whereas the passage 13 is radial in figure 7, the corresponding passage 113 is elbow-shaped in figure 8. Two further

variants, shown in figures 9 and 10 are respectively similar to those of figures 7 and 8, where the unit according to the invention further includes a device C for detecting rotational speed.

As will be appreciated, by virtue of the present invention pressurized air can be supplied through the hub of the wheel by using a "standard" bearing lacking air passages through its races. The variants shown in figures 3, 6, 8 and 10 further allow to avoid to form air ducts through the suspension standard.

It is to be understood that the invention is not limited to the embodiments here described and illustrated which are to be considered as examples of the air supplying device and the bearing assembly according to the invention. The invention is likely to undergo modifications as to shape and location of parts, constructional and functional details. For example, those skilled in the art will recognized that, with some modifications, the invention is equally applicable to bearing units or hub-bearing units in which the rotatable race is radially outer and the stationary race is radially inner.